DENTAL X-RAY UNIT
GE-100

Radiographic Technic

Direction 13156

X-RAY DEPARTMENT
GENERAL ELECTRIC
MILWAUKEE 1, WISCONSIN

Code 11-165

IMPORTANT . . . X-RAY PROTECTION

X-Ray equipment if not properly used, may cause injury. Accordingly the instructions herein contained should be thoroughly read and understood before you attempt to place this equipment in operation. The General Electric Company, X-Ray Department, will be glad to assist and cooperate in placing this equipment in use.

Although this apparatus incorporates a high degree of protection against x-radiation other than the useful beam, no practical design of equipment can provide complete protection. Nor can any practical design compel the operator or his assistant to take adequate precautions or prevent the possibility of authorized or unauthorized persons carelessly, unwisely, or unknowingly exposing themselves or others to direct or secondary radiation.

It is important that everyone having anything to do with x-radiation be fully acquainted with the recommendations of the National Committee on Radiation Protection as published in the National Bureau of Standards Handbooks, of the American Standards Association, and of the International Commission on Radiation Protection, and take adequate steps to insure protection against injury.

It is assumed that all persons authorized to use the equipment are cognizant of the danger of excessive exposure to x-radiation and the equipment is sold with the understanding that the General Electric Company, X-Ray Department, its agents, and representatives have no responsibility for injury or damage which may result from exposure to x-radiation.

Various protective material and devices are available. It is urged that such materials or devices be used.

RADIOGRAPHIC TECHNIC

FOR GE-100

Foreword

In the past few years many advances have occurred in dental x-ray apparatus. In this same period many improvements in films, chemicals and technics have also been introduced. To provide the flexibility of function demanded by modern technical procedures, the GE 90-II has been made available to the profession. Whether you wish to use exposure times as short as 1/60 second - fast or slow films - bisecting-angle or the long-distance technics, you will find the GE-100 perfectly adaptable to your requirements.

Bisecting Angle Technic

This is the 8-inch technic long familiar in dental radiography. The central ray from the x-ray tube is directed at a right angle to the imaginary line which bisects the angle created by the central axis of the teeth and the plane of the film. The vertico-horizontal angles are measured by the calibrations of the angle scale on the tube head -- the mesio-distal angles are determined by the dental landmarks. Because of the shorter focal-skin distance, slight changes in tube angle may produce superimposition, foreshortening or elongation of the dental structures. For duplication of results, it is a more difficult procedure than the long distance technic.

Long-Distance Intra-Oral Technic

The value of dental radiographic examinations depends upon the quality of the radiographs and their exact interpretation. Radiographic quality not only requires good definition of the dental structures but must portray these structures as they actually exist with maximum anatomic accuracy.

The most commonly used dental technics are based on the "bisecting angle" theory. Although satisfactory results have been obtained by using this tech-

2. McCormack, Donald W., .Dental Roentgenology: A technical Procedure for Furthering the Advancement Toward Anatomical Accuracy, J. California, D.A. 13-89 (May-June) 1937. Mechanical Aids for Obtaining Accuracy in Dental Roentgenology, J.A.D.A. 40:2 (Feb.) 1950.

3. McCormack, Franklin W. A., A Plea for a Standardized Technic for Oral Radiography, J.D. Res. 11:467 (Sept.) 1920.

4. Appleman, Robert M., The Extended Tube Technique in Intra-Oral Roentgenography. Am. J. Roentgenol & Rad. Therapy, (Dec.) 1949, 62, 881-889.

5. Waggener, Donald T., The Principles of the Long Tube Technique, J. Nebraska D. Soc. 24:3 (Dec.) 1947.

High Voltage Technics

Although it is not intended to discuss fully high kvp technics in these instructions, further information on this procedure may be obtained by consulting the following bibliography:

1. Fitzgerald, G. M.: Dental Roentgenography IV. The Voltage Factor (kvp) J. Am. Dent. A. 41: 19-28, July 1950.

2. Fuchs, A. W. Relationship of Tissue Thickness to Kilovoltage. X-Ray Technician 19:287-293, May 1948.

3. Trout, E. D., Graves D. E., and Slauson, D. B.: High-Kilovoltage Radiography. Radiology 52: 669-682, May 1949.

4. Hodges, F. J., Holt, J. F. and Lampe I (editors): Year Book of Radiology. Chicago, Year Book Publishers, Inc. 1949, pp 12-14.

5. Fuchs, A. W.: Optimum Kilovoltage Technique in Military Roentgenography. Am. J. Roentgenol. 50: 358-365, September 1943.

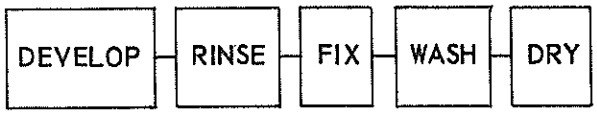
6. Waggener, D. T., Principles of the Long Tube Technique. J. Nebraska State Dent. A. 24: 3-8, December 1947.

7. Wuehrmann, A. H., D.M.D., Monacelli, C. J., D.M.D.; Selection of Optimum Kilovoltage for Dental Radiography. (Reprinted from Radiology, Vol. 57, No. 2, Pages 240-47, August 1951.)

8. Wuehrmann, A. H., Curby, W. A.: Radiopacity of Oral Structures as Basis for Selecting Optimum Kilovoltage for Intraoral Roentgenograms. (Reprinted from Journal of Dental Research – Vol. 31, No. 1 pp 27-32, February 1952.)

Processing

A single piece of unexposed dental x-ray film lists for less than 5 cents. To expose this film the user will spend perhaps better than one thousand dollars for x-ray apparatus. The quality of the radiograph depends not only on the apparatus used but on proper film processing as well. It would certainly be inconsistent, therefore, to demand x-ray apparatus that provides precise accuracy while tolerating processing errors as great as 100%. Unfortunately such paradoxical situations are all too common today. To help you avoid such errors, this section has been prepared.



1. **Developer.** The purpose of a developing solution is threefold:

   (a.) To blacken those parts of the emulsion which have received full exposure.

   (b.) To produce various shades of gray for partial exposure.

   (c.) To leave unchanged film areas which have received no exposure.

   To accomplish the above, various chemicals are included in the solutions. Two developing agents are commonly used in x-ray solutions.

   METOL AND PHENIDONE

   Produces grays

   1. works quickly
   2. produces over a wide temperature range

   HYDROQUINONE

   Produces blacks (contrast)

   1. works slowly
   2. produces over narrow temperature range – inactive in cold solutions (50° F. colder)

Optimum development contrast (normal or maximum) is desired for any type of exposure. Because hydroquinone is responsible for the blacks, it is evident that optimum contrast will be produced when:

1. Full development is permitted as shown in the chart below.

2. Temperature range is from 63 – 80° F, preferably 68°F.

films should not be left in the fixer longer than three times the clearing time -- in this case, three minutes.

4. **Wash.** The object in washing films is to remove the chemicals present after fixing. If the film is not sufficiently washed, the image may fade or stain a yellowish brown color. Dental films should be washed in running water for 20 minutes.

   The ideal temperature of the wash water is 68-70° F. Chemicals will not be removed from the film emulsion if the temperature of the wash water is below 50° F.

5. **Dry.** The final step in processing is the drying of the film. Where few films are processed daily, the hanger may be suspended and left with or without a fan directing an air blast over them.

   If much work is being done, a conditioned air dryer should be used. Drying time may be accelerated if the films are first drained or shaken to remove excess droplets of water.

Technic Chart Instructions

The GE-100 provides more flexibility in technical factors than any dental x-ray apparatus heretofore available.

The following technic charts indicate a few of the possible variations which may be used. They are intended to approach optimum end results. These charts are compiled as a basis from which the equipment user may work out his personal radiographic technics. To use the chart it is necessary to:

1. Select film speed.

2. Determine the type of technic to be used.

3. Determine the working distance. In all cases this distance will be from the target of the x-ray tube to the patient's skin. (FSD) For example, if it is desired to use the GE-100 with fast film at 100 KVP, 10MA and a distance of 8", the exposure time for various regions will be found by reading down column 1, chart 1. (See column 2 for 90 KVP, 15MA exposure times). For medium speed film, see footnote #5.

   If the suggested technic does not produce satisfactory results, a second column is provided for writing in the selected technic. The selected technic should be obtained by varying exposure time and keeping milliamperage (MA) and kilovoltage (KVP) constant.

   The GE-100 timer positions have been selected to provide, per step change, equal incremental changes in radiographic density. Thus, if a change in time is made from any given time position to the next shorter or longer time position there will be an equal percentage change in density.

   On the GE-100 Dental X-Ray Unit MA and KVP can be varied if difficulty is encountered in achieving desired results by varying time only. When technical factors are varied change only one factor at a time. In accomplishing a desired technic, some experimentation cannot be avoided. Individual preferences will always dictate the final variations that will be necessary.

4. For extra-oral radiography of the head use Technic Chart #2.

   The exposure times given in Chart #2 are for 15 MA technics. If the MA is reduced the exposure time should be proportionally increased. For example, at 10 MA, increase the exposure time by a factor of 1.5 or as close to this as the time selector on the control will allow.

   If bisecting angulation is used, the following approximate vertical angulation of the x-ray tube head should be used for the various tooth areas:

BISECTING ANGLE TECHNIC

Upper	Region	Lower
25°	2nd - 3rd Molar	5°
32°	1st Molar - Biscupids	-10°
45°	Cuspids	-18°
40°	Incisors - R. or L.	-15°
40°	Incisors - Central	-15°

A D U L T T E C H N I C C H A R T #1

GE-100 Dental X-ray Unit

TECHNICAL FACTORS

For 8" F.S.D. Open Cone
Total Built-in Filtration - Equivalent to 2.5 mm Al.
Film-Fast (Such as Eastman Ultra Speed or DuPont Lightning)
Processing - 5 Min. at 68° F - GE Supermix Dental Developer

EXPOSURE TIME IN SECONDS

	100 KVP 10 MA		90 KVP 15 MA	
	TIMER VALUES		TIMER VALUES	
Upper Areas	Suggested	Selected	Suggested	Selected
2nd Molar	4/60		4/60	
1st Bicuspid	4/60		4/60	
Cuspid	3/60		3/60	
Central	3/60		3/60	
Lower Areas	Suggested	Selected	Suggested	Selected
2nd Molar	4/60		4/60	
1st Bicuspid	4/60		4/60	
Cuspid	3/60		3/60	
Central	3/60		3/60	
Bite Wing	Suggested	Selected	Suggested	Selected
Anterior	3/60		3/60	
Posterior	4/60		4/60	

NOTES:

1. For 12" open cone use 2 times above exposure
2. For 16" open cone use 4 times above exposure
3. For children under 10 yrs. use approx. 1/2 above exposure.
4. For edentuious areas use 1/3 above exposure
5. For Med. speed film such as Eastman radiatized or DuPont D-1 use 5 times above exposure

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A D U L T T E C H N I C C H A R T #2

Extra Oral Technic

GE-100 Dental X-ray Unit

TECHNICAL FACTORS:

Built-in filtration - equivalent to 2.5 mm Al.
Development time - 5 min at 68° F using
GE Supermix Dental Developer
Intensifying Screen - medium speed
Film - medium speed

Part	Position	FFD	Cone	Kvp	Ma	Suggested Time	Selected Time
Jaw	Lat.	25"	8"	65	15	15/60	
Mastoid	Lat.	25"	16"	90	15	5/60	
Temporal Mandibular Articulation	Lat.	25"	16"	90	15	5/60	
Sphenoid Sinus	Anterior (PA)	25"	8"	90	15	15/60	
Frontal Sinus	Anterior (PA)	25"	8"	90	15	10/60	
Cephalometric Head	Lat.	*60"	8"	90	15	10/60	
Cephalometric Head	Anterior (PA)	*60"	8"	90	15	15/60	

NOTES:
To radiograph a part smaller than the average part reduce time 50%.
To radiograph a part larger than the average part increase time 50%.

Exposure value must be corrected for intensifying screen speeds and film speeds other than medium speed.

*60" distance measured from focal spot to sagittal plane.

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